

Indigofera jintongpenensis (Fabaceae, Papilionoideae, Indigofereae), a new species from Yunnan, southwest China

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Abstract

Indigofera jintongpenensis, a new species of the subfamily Papilionoideae of Fabaceae, is described and illustrated from Yunnan, southwest China. The new species is characterised by having a prostrate habit, flexible stems and branches, as well as spreading, sub-basifixed, asymmetrically 2-branched trichomes covering the entire plant, discoid calyx, and racemose inflorescences 6–8-flowered, short, 1–2 (–3.5) cm in length, apparently shorter than the leaf. A distribution map and comparison of morphological diagnostic characters with its morphologically similar species are provided. Additionally, a preliminary conservation assessment of *I. jintongpenensis* is proposed following IUCN criteria.

Key words: Endemism, Indigofereae, Jintongpen Mountain, mat-forming, short inflorescence, taxonomy



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Introduction

Indigofera L. is a legume genus belonging to the tribe Indigofereae of the subfamily Papilionoideae (Schrire et al. 2005; Azani et al. 2017). With approximately 750 species (Schrire et al. 2009), it is the third largest genus in Fabaceae. The genus is mainly distributed in tropical and subtropical regions worldwide with centres of species diversity primarily occurring in Africa (ca. 550 species), the Sino-Himalayan region (ca. 105 species), Australia (ca. 50 species) and the New World (ca. 45 species) (Schrire et al. 2009). Species of *Indigofera* are typically shrubs, but some are small trees, herbaceous perennials or annuals. The genus is characterised by a combination of the presence of medifixed 2-branched trichomes, pulvinate leaves, axillary simple racemes, anthers with appendiculate connective and flowers with an explosive pollen display (Hutchinson 1964; De Kort and Thijssse 1984). The genus includes economically important species with a variety of uses (Gerometta et al. 2020). Notably, *I. tinctoria* L. and *I. suffruticosa* Mill. are the principal sources for production of natural indigo (Zhang et al. 2019).

China harbours a high level of diversity for *Indigofera* species, including many endemics, with the highest species diversity found in the south-western China (Yin et al. 1992; Gao and Schrire 2010). The first comprehensive revision for Chinese *Indigofera* was proposed by Craib (1913), recognising 57 species with 31 newly named. In the Flora Reipublicae Popularis Sinicae, Fang and Zheng (1994) recognised 81 species and nine varieties. In the latest treatment by Gao and Schrire (2010) in the Flora of China, 79 species and nine varieties were accepted, 45 of which are endemic. Recently, Zhao and Gao (2015), Zhao et al. (2020) and Liu et al. (2022) described three additional species of *Indigofera* in southwest China, highlighting the need for continued field exploration and taxonomical research of the genus in this area.

During our recent field surveys in preparation for a taxonomic revision of the genus *Indigofera* of Yunnan Province in southwest China, we collected an intriguing prostrate plant with a densely spreading indumentum on Jintongpen Mountain of Fumin County. Its racemose inflorescences are relatively short, bearing few flowers. After conducting extensive literature surveys and comparison with related specimens, we concluded this plant does not match with any of the previously described species. Therefore, it is described herein as a new species.

Materials and methods

The study followed the normal practice of plant taxonomic survey and herbarium taxonomy. Morphological studies of the new species were based on observation of living plants and specimens collected from the type locality. Digital images available at the JSTOR Global Plants (<http://plants.jstor.org/>) and at the Chinese Virtual Herbarium (<http://www.cvh.ac.cn/>), as well the collections housed at CDBI, KUN, PE, PYU, XTBG and YUKU were examined and compared with the new species. Relevant taxonomic literature (e.g. Craib (1913); Fang and Zheng (1994); Sun (2006); Gao and Schrire (2009, 2010); Chauhan et al. (2013); Clark et al. (2015); Pignal and De Queiroz (2019)) was consulted. Morphological studies were carried out on dried material under a stereomicroscope (Olympus SZX2, Tokyo, Japan) and measurements were made using a ruler and a metric vernier caliper. Terminology followed Gao and Schrire (2010).

Taxonomy

***Indigofera jintongpenensis* Huan C.Wang, L.Yao & X.L.Zhao, sp. nov.**

urn:lsid:ipni.org:names:77339921-1

Figs 1–4

Type. CHINA. Yunnan Province: Fumin County, Jintongpen Mountain, alt. 2,730 m, in the scrub of the limestone mountains, 10 June 2022, *H. C. Wang et al.* FM16943 (Holotype: YUKU!; isotypes: YUKU!)

Diagnosis. *Indigofera jintongpenensis* is most morphologically similar to *I. balfouriana* Craib, but it clearly differs from the latter by its habit being prostrate (vs. erect), much-branched stems and branches flexible, leaves usually 7–13-foliate (vs. 5–9-foliate), stipules usually 5–7 mm (vs. 3–6 mm) long, inflorescences racemose, 1–2 (–3.5) cm (vs. 2–6 cm) long, 6–8-flowered, legumes 1.5–2.5 cm (vs. 2.5–4.0 cm) long, endocarp not blotched (vs. blotched).

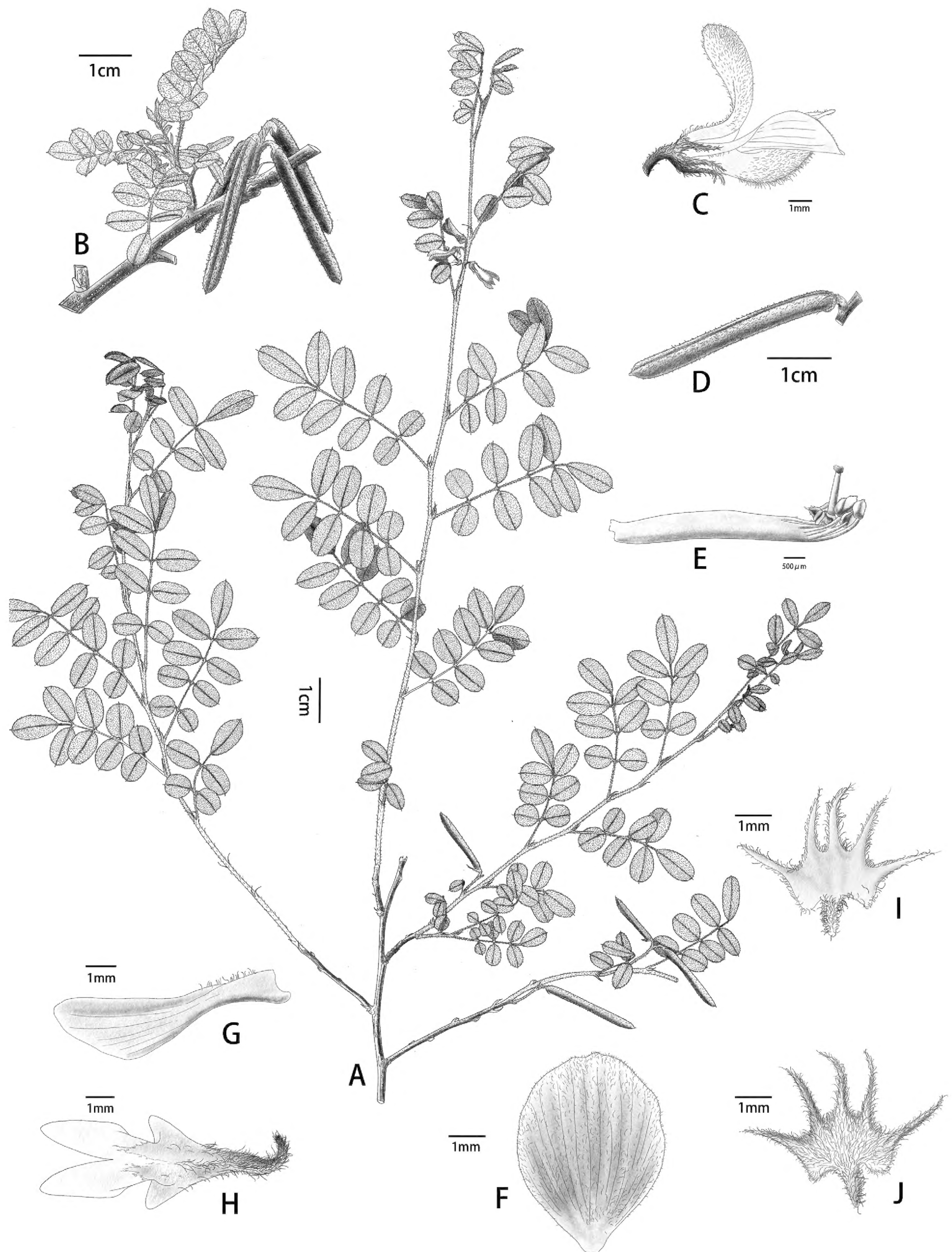


Figure 1. *Indigofera jintongpenensis* sp. nov. **A** habit **B** fruit branch **C** flower (side view) **D** legume **E** style **F** standard **G** wing **H** keel **I** calyx (glabrous inside) **J** calyx (outside with spreading sub-basifixed 2-branched trichomes).

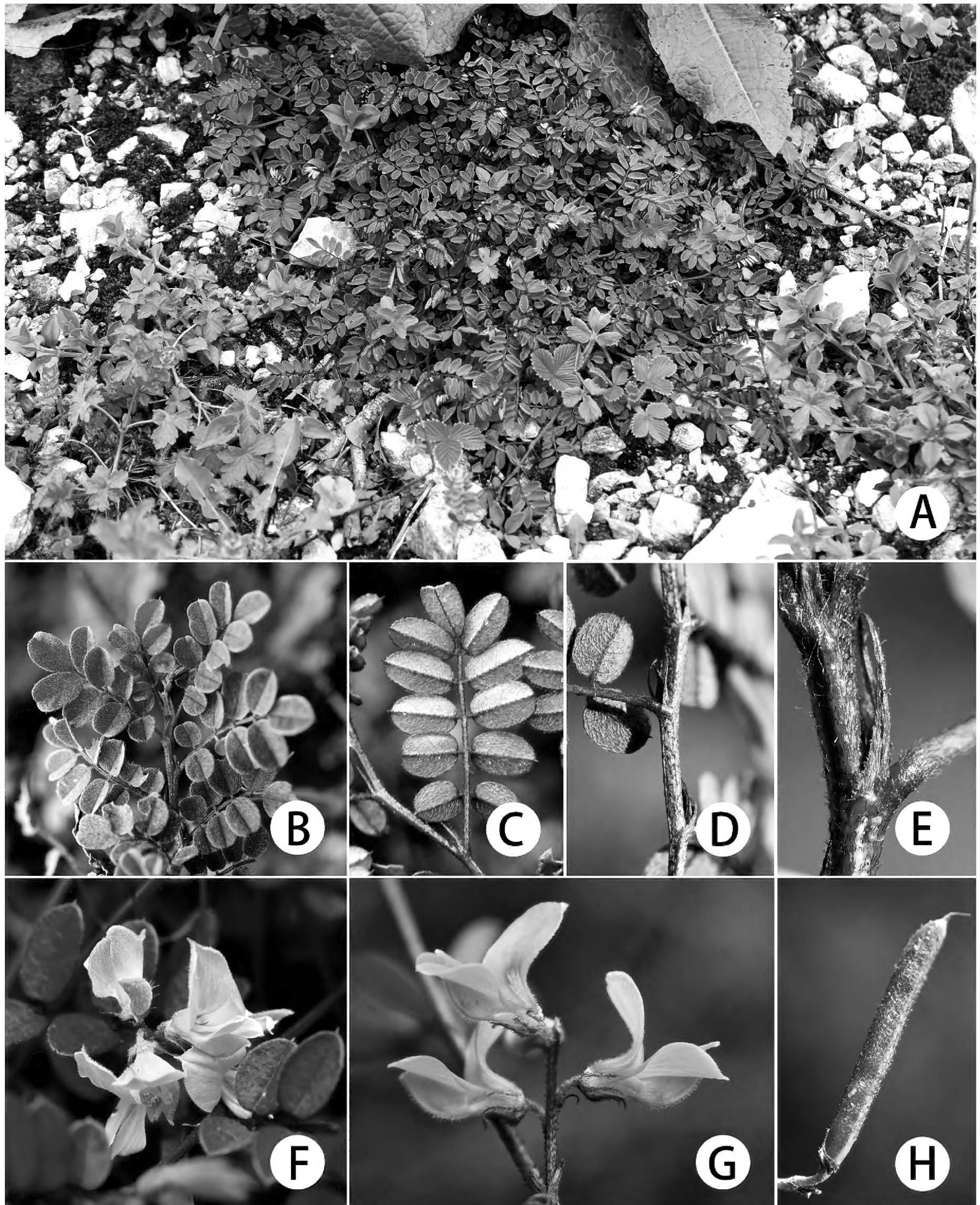


Figure 2. *Indigofera jintongpenensis* sp. nov. **A** habit **B** a portion of branchlet showing adaxial surface of leaflets **C** leaves (abaxial) **D** branchlet **E** stipules **F** leaves and inflorescence **G** inflorescence **H** legume.

Description. Shrubs, prostrate, 10–20 (–30) cm in height. Stems much-branched, terete, slightly 4-angled when young, flexible, usually 1.0–2.5 mm in diameter. Branchlets nearly terete, flexible, 10–20 cm long, with dense spreading white and brown sub-basifixed curly and asymmetrically 2-branched trichomes.



Figure 3. Holotype of *Indigofera jintongpenensis* (YUKU-05008413).

Leaves imparipinnate, 2–7 cm × 1.0–2.5 cm, 7–13-foliolate. Stipules narrowly triangular to linear, 5–7 mm long, purple when young, turning brown when old, with spreading, brown, curled and asymmetrically 2-branched trichomes. Petioles 0.2–1.0 cm long, rachis adaxially grooved, with spreading, curled, sub-basifixed, brownish-black, 2-branched trichomes. Leaflets opposite, 0.5–1.5 cm × 0.4–0.8 cm, adaxial surface green, covered with short, spreading, white, 2-branched trichomes, abaxial surface pale green, covered with long, spreading, sub-medifixed, white, 2-branched trichomes and brown, 2-branched trichomes along primary venation; mid-vein abaxially prominent and adaxially impressed, secondary veins inconspicuous; terminal leaflets obovate, apex rounded or retuse, base broadly cuneate; lateral leaflets oblong or elliptic, apex rounded, with a mucro ca. 1 mm long, base rounded or shallowly cordate; petiolules ca. 1 mm long. Inflorescences racemose, 6–8-flowered, axillary, obviously shorter than their subtending leaf, 1–2 (–3.5) cm long. Peduncles 0.2–0.5 cm long; peduncle and rachis densely covered with spreading, white and brown, sub-basifixed, curly and asymmetrically 2-branched trichomes. Bracts narrowly lanceolate to linear, revolute, ca. 2 mm long, caducous. Pedicels ca. 2 mm long, slightly curved, with densely spreading, sub-basifixed, white and brown, 2-branched trichomes. Calyx discoid, spreading, outside with spreading brown and white, sub-basifixed, asymmetrically 2-branched trichomes, glabrous inside; tube ca. 1 mm long; lobes 5, unequal, triangular-lanceolate, ca. 1.5–2.0 mm long, apex long acuminate. Corolla pink; standard obovate-elliptic, 7–9 mm × 4–6 mm, apex rounded, base broadly cuneate, outside with white, soft, 2-branched trichomes, margin ciliate; wings narrowly oblong, ca. 8 mm long, ca. 2 mm wide, base bristly, margin ciliate; keel petals 7–9 mm × ca. 1.5 mm, outside covered with spreading white trichomes towards apex, with spur ca. 1 mm long. Stamens 10, diadelphous, 9 stamens fused and the vexillary one free, 5–6 mm long; anthers ovoid, apically convex. Ovary hairy; style glabrous. Legume cylindrical, sutures thickened, 1.5–2.5 cm × ca. 0.2 cm, apex beaked, with white and brown, medifixed, symmetrically 2-branched trichomes, endocarp not blotched. Seeds 5–7 per legume, oblong to rectangle, 1–2 mm × ca. 1 mm, transverse septa present between seeds.

Phenology. Flowering from June to September, fruiting from August to December.

Etymology. The specific epithet “*jintongpenensis*” is derived from the type locality of the new species, the Jintongpen Mountain and the Latin suffix *-ensis*, indicating the place of origin or growth.

Distribution and ecology. According to the present investigations, *Indigofera jintongpenensis* is only found in its type locality, the Jintongpen Mountain of Fuming County, located in central Yunnan Province, southwest China (Fig. 5). With a maximum altitude of 2,817 m, the Jintongpen Mountain is the highest peak in Fuming County. *I. jintongpenensis* has been observed at elevations ranging from 2600–2817 m in the summit region of the mountain. It usually grows in the limestone scrub and its association includes *Allium wallichii* Kunth (Amaryllidaceae), *Asparagus filicinus* Buch.-Ham. ex D.Don (Asparagaceae), *Berberis wilsoniae* Hemsley (Berberidaceae), *Buddleja myriantha* Diels (Scrophulariaceae), *Impatiens yaoshanensis* K.M.Liu & Y.Y.Cong (Balsaminaceae), *Lolium perenne* Linn. (Poaceae), *Quercus pannosa* Hand.-Mazz. (Fagaceae), *Quercus rehderiana* Handel-Mazzetti (Fagaceae), *Silene gracilicaulis* C.L.Tang (Caryophyllaceae) and so on. It can also be found occasionally under the thickets predominated by *Quercus pannosa* Hand.-Mazz. (Fagaceae).

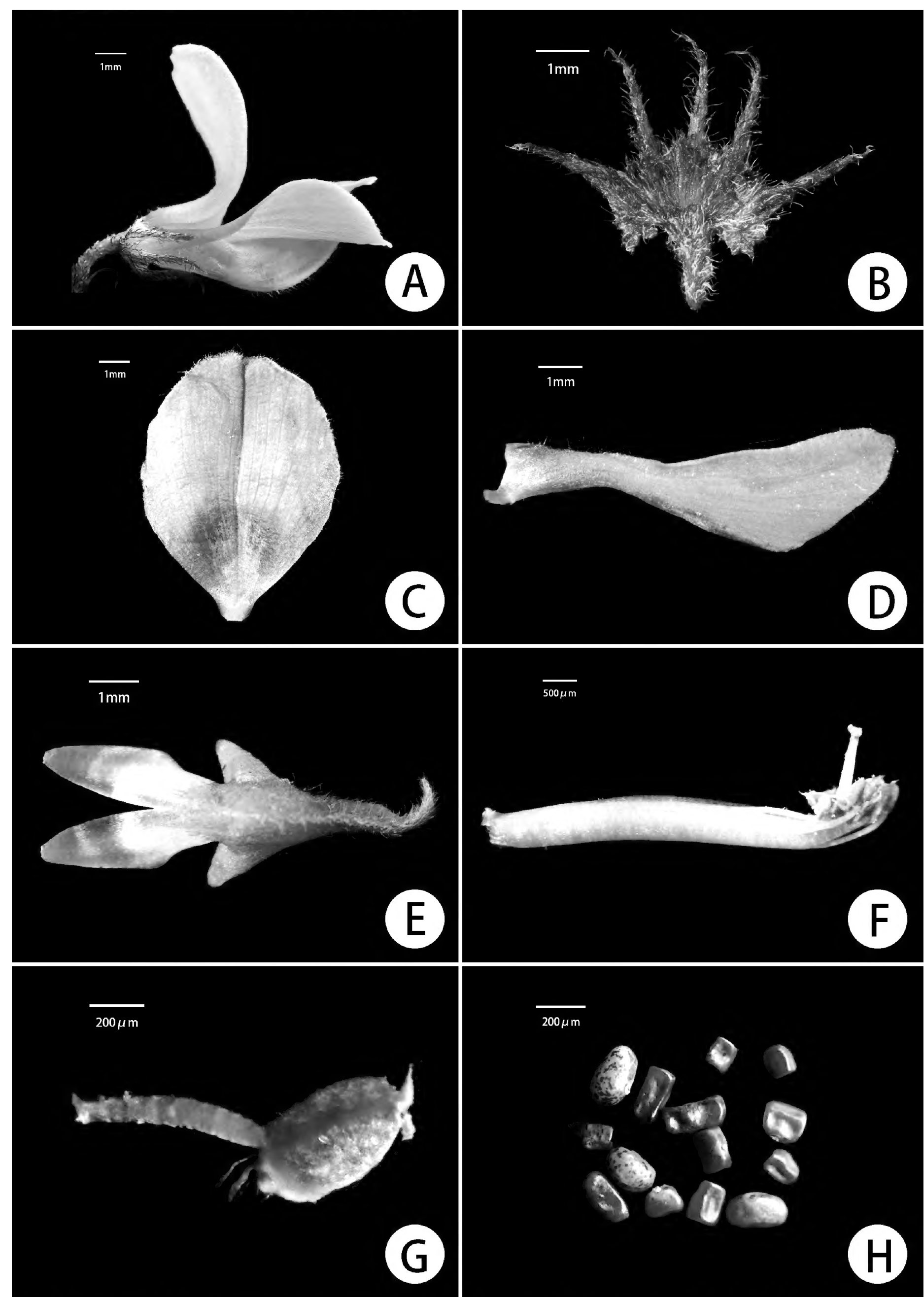


Figure 4. *Indigofera jintongpenensis* sp. nov. **A** flower (lateral view) **B** calyx **C** standard **D** wing **E** keel **F** pistil and stamens **G** stamen **H** seeds.

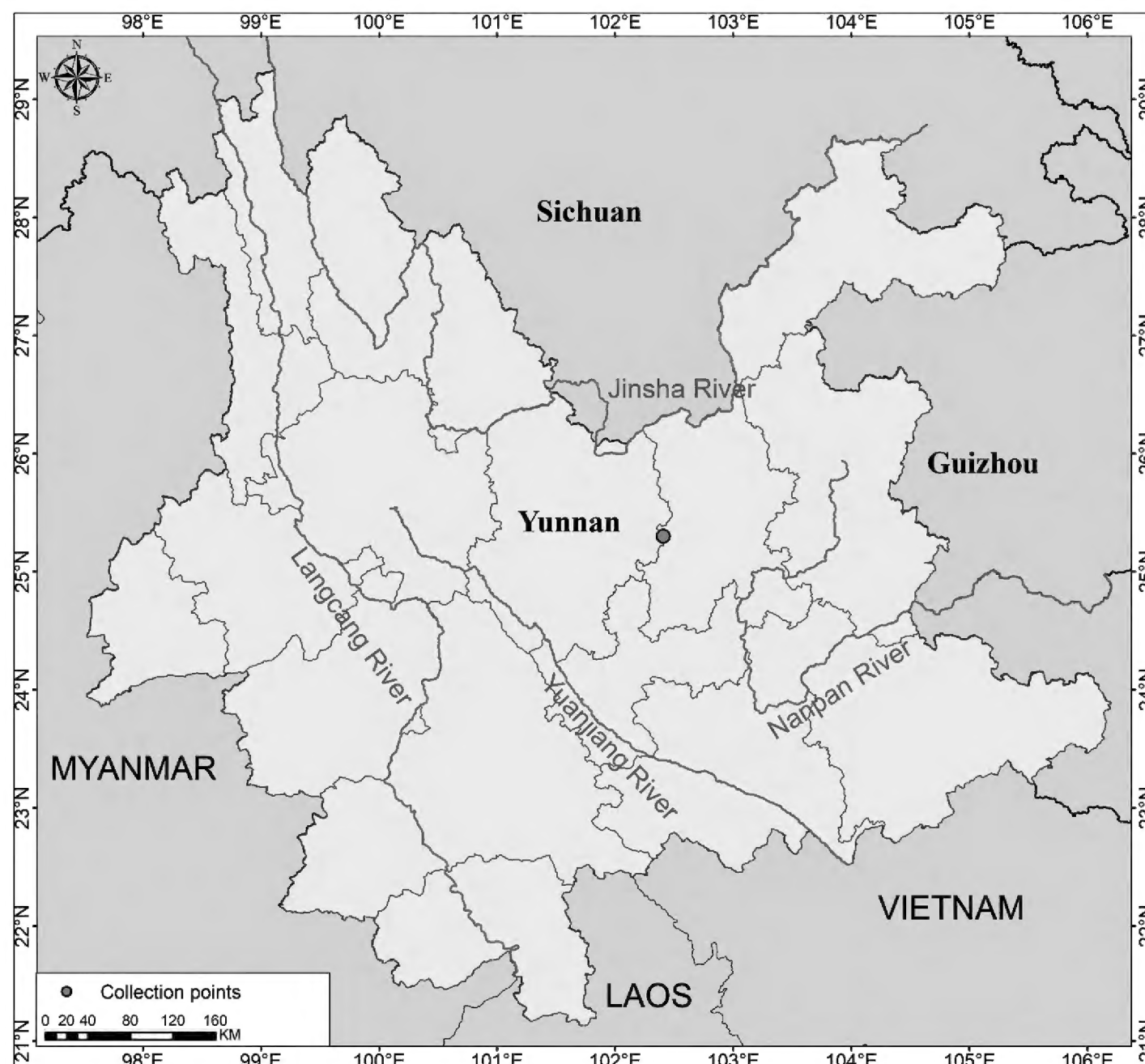


Figure 5. Geographical distribution of *Indigofera jintongpenensis* sp. nov. (red dot).

Conservation status. *Indigofera jintongpenensis* is a rare species with a restricted distribution and small population size. It is only known from a single locality on the Jintongpen Mountain in the Fumin County, southwest China, which is not within any protected area. The estimated area of occupancy (AOO) is less than 20 km². The total population size is estimated to be fewer than 250 mature individuals. Following the IUCN criteria (IUCN 2022), this new species should be classified as Endangered [EN (B2abiii, D)].

Taxonomic notes. *Indigofera jintongpenensis* is mainly characterised by having a prostrate habit, 2-branched trichomes that are spreading and asymmetrical, and racemose inflorescences that are 6–8-flowered and relatively short (mostly 1–2 cm in length). It is most morphologically similar to *I. balfouriana* Craib in terms of indumentum on various parts of the plant, as well as flower shape and size, but is clearly distinguished by the features pointed out in the diagnosis as well as others (Table 1).

Indigofera jintongpenensis is also similar to *Indigofera szechuensis* Craib in overlapping leaf length, the number of leaflets and overlapping standard size (Table 1). However, *I. szechuensis* differs from *I. jintongpenensis* in having an erect habit, 2-branched trichomes appressed, symmetrical and medifixed, stipules 2.5 mm long, inflorescences 10–19 cm long, peduncles 8–27 mm long (Table 1).

Additional specimens examined (Paratypes). CHINA. Yunnan: Fumin County, Jintongpen Mountain, alt. 2770 m, 6 September 2023, H. C. Wang et al. FM22978, FM22988, FM23008 (YUKU); Fumin County, Jintongpen Mountain, alt. 2710 m, 2 November 2023, H. C. Wang et al. FM23540 (YUKU).

Table 1. Morphological comparison amongst *Indigofera jintongpenensis* and the related species.

Character	<i>I. jintongpenensis</i>	<i>I. balfouriana</i>	<i>I. szechuensis</i>
Habit	prostrate shrub	erect shrub	erect shrub
Plant height (m)	0.1–0.2 (–0.3)	0.6–2.0	0.8–2.5
Stems	prostrate	erect	erect
Stem indumentum	spreading, sub-basifixed curly and asymmetrical	spreading or subspreading appressed or 2-branched	appressed mixed and medifixed symmetrically
Leaf length (cm)	2–7	3–9	4–10
Stipule size (mm)	5–7	3–6	up to 2.5
No. of leaflets	7–13	5–9	(5–) 7–13
Leaflet size (mm)	5–15 × 4–8	6–20 × 4–13	5–20 × 4–9
Raceme length (cm)	1–2 (–3.5)	2–6	10–19
Peduncle size (cm)	0.2–0.5	0.5–1.5	0.8–2.7
Calyx shape	discoïd	bell-shaped	cup-shaped
Colour of corolla	pink	red to purple	crimson-red
Standard size (mm)	7–9 × 4–6	6.0–9.5 × 5.0–6.0	7.5–9.5 × 5.0–6.5
Legume length (cm)	1.5–2.5	2.5–4.0	3.5–4.0

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Investigation: HCW, LY, QPW, XLZ, YY. Writing – original draft: LY. Writing – review and editing: HCW, LY.

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Data availability

All of the data that support the findings of this study are available in the main text.

References

- Chauhan V, Pandey AK, Schaefer H (2013) *Indigofera himachalensis* (Fabaceae: Indigofereae), a new species from Himachal Pradesh, India. *Phytotaxa* 112(2): 43–49. <https://doi.org/10.11646/phytotaxa.112.2.2>
- Clark VR, Schrire BD, Barker NP (2015) Two new species of *Indigofera* L. (Leguminosae) from the Sneeuberg Centre of Floristic Endemism, Great Escarpment (Eastern and Western Cape, South Africa). *PhytoKeys* 48: 29–41. <https://doi.org/10.3897/phytokeys.48.4798>
- Craib WG (1913) The Indigoferas of China. Notes from the Royal Botanic Garden Edinburgh 8: 47–78.
- De Kort I, Thijsse G (1984) A revision of the genus *Indigofera* (Leguminosae-Papilionoideae) in Southeast Asia. *Blumea* 30: 89–151.
- Fang YY, Zheng CZ (1994) *Indigofera* L. In: Wu ZY (Ed.) *Flora Reipublicae Popularis Sinicae*. Vol. 40. Science Press, Beijing, 239–325.
- Gao XF, Schrire BD (2009) Three new species of *Indigofera* (Leguminosae) from China. *Novon: A Journal for Botanical Nomenclature* 19: 159–163. <https://doi.org/10.3417/2008105>
- Gao XF, Schrire BD (2010) *Indigofera* L. In: Wu ZY, Raven PH (Eds) *Flora of China*, vol. 10. Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis, Missouri, 137–164.
- Gerometta E, Grondin I, Smadja J, Frederichb M, Gauvin-Bialecki A (2020) A review of traditional uses, phytochemistry and pharmacology of the genus *Indigofera*. *Journal of Ethnopharmacology* 253: 112608. <https://doi.org/10.1016/j.jep.2020.112608>
- Hutchinson J (1964) *The genera of Flowering Plants (Angiospermae), I: Dicotyledons*. Clarendon Press, Oxford.
- IUCN (2022) *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 15. Prepared by the Standards and Petitions Committee.
- Liu JL, Li SG, Yang F, Wang HC (2022) *Indigofera vallicola* (Fabaceae), a new species from Yunnan, southwest China. *PhytoKeys* 199: 9–16. <https://doi.org/10.3897/phytokeys.199.85437>
- LPWG (2017) A new subfamily classification of the Leguminosae based on a taxonomically comprehensive phylogeny – The Legume Phylogeny Working Group (LPWG). *Taxon* 66(1): 44–77.
- Pignal M, De Queiroz LP (2019) The genus *Indigofera* (Leguminosae) in New Caledonia: Two new species and a key for the species. *PhytoKeys* 119: 53–66. <https://doi.org/10.3897/phytokeys.119.32221>
- Schrire BD, Lavin M, Lewis GP, Friis I, Balslev H (2005) Global distribution patterns of the Leguminosae: Insights from recent phylogenies. *Biologiske Skrifter* 55: 375–422.
- Schrire BD, Lavin M, Barker NP, Forest F (2009) Phylogeny of the tribe Indigofereae (Leguminosae-Papilionoideae): Geographically structured more in succulent-rich and temperate settings than in grass-rich environments. *American Journal of Botany* 96(4): 816–852. <https://doi.org/10.3732/ajb.0800185>
- Sun H (2006) *Indigofera* Linnaeus. In: Wu ZY (Ed.) *Flora Yunnanica*. vol. 10. Science Press, Beijing, 439–481.

- Yin GP, Chen SL, Xiao XH, Chen SY (1992) The numerical analysis of the distribution patterns and exploitation of the resources of Chinese *Indigofera*. *Guihaia* 12(1): 22–32.
- Zhang L, Wang L, Cunningham AB, Shi Y, Wang Y (2019) Island blues: Indigenous knowledge of indigo-yielding plant species used by hainan miao and Li dyers on hainan island, China. *Journal of Ethnobiology and Ethnomedicine* 15(1): 1–9. <https://doi.org/10.1186/s13002-019-0314-3>
- Zhao XL, Gao XF (2015) *Indigofera pseudonigrescens* (Fabaceae: Papilionoideae): A new species from Sichuan, China. *Phytotaxa* 222(4): 251–258. <https://doi.org/10.11646/phytotaxa.222.4.2>
- Zhao XL, Jiang LS, Gao XF (2020) *Indigofera yuanjiangensis* (Fabaceae: Papilionoideae): a new species from Yunnan, China. *Phytotaxa* 455(3): 235–239. <https://doi.org/10.11646/phytotaxa.455.3.7>